

UTILITY APPLICATION
FOR
UNITED STATES LETTER PATENT

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Title: **Optical Fiber Bundle Utilizing Electromagnetic
Radiation Feedback**

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I hereby certify that this paper, fee transmittal, utility transmittal, 8 page application, PTO 1449 and Information Disclosure Stmt., with reference; Declaration, 3 sets of informal drawings, a check in the amount of \$385.00 is being deposited with the United States Postal Service as Express Mail with a label no. of EV 394767503 on November 17, 2003 to Mail Stop Patent Application, Commissioner for Patents; PO Box 1450, Alexandria VA 22313-1450


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Patent Application Of: Ronald E. Drake, Sr., Matthew R. Drake, and Ronald E. Drake, Jr.

For: Optical Fiber Bundle Utilizing Electromagnetic Radiation Feedback

BACKGROUND OF THE INVENTION

[0001] This application claims priority to provisional application Serial No. 60/427,080, filed on November 15, 2002.

CROSS-REFERENCE TO RELATED APPLICATION

1. **Field of Invention**

[0002] The present invention relates generally to light transmitting optical fiber bundles and, more particularly, to such bundles that monitor and control the level of output provided by the light (EMR) source to maintain a low variability in the output of the transmitting fibers.

2. **Description of Prior Art**

[0003] Fiber optic fibers are used for transmitting light. The fibers may be flexible or rigid, and a plurality of fibers may be grouped or bundled together in a common ferrule. The ferrule is typically connected to a light (EMR) source that outputs light into the fibers. The light is then transmitted through internal reflection along the length of the fibers and is output at their distal or terminal ends. The light output from the bundle may be used in a wide variety of useful applications, such as dental and surgical instruments, welding equipment, and other apparatus well know in the fiber manufacturing industry.

[0004] The amount of light lost through an entire bundle can vary significantly from one moment to the next due to factors such as the orientations of the fibers and the variation in light (EMR) source output. In applications that require a low tolerance for the amount of light output from the bundle, it is desirable to monitor the output levels and adjust the light (EMR) source accordingly.

3. **Objects and Advantages**

[0005] It is a principal object and advantage of the present invention to provide a device that is capable of monitoring the amount of EMR variation during transmission, and adjusting the EMR source accordingly.

[0006] It is an additional object and advantage of the present invention to provide a device that may be incorporated into a transmitting fiber bundle.

[0007] Other objects and advantages of the present invention will in part be obvious, and in part appear hereinafter.

SUMMARY OF THE INVENTION

[0008] In accordance with the foregoing objects and advantages, the present invention provides a set of “parasitic” optical fibers randomly distributed among a bundle of transmitting fibers. The parasitic fibers are joined together via a ferrule that is separate from the ferrule that joins the transmitting fibers. The parasitic fibers are not connected to the EMR source, and have no “original” light being transmitting therethrough. The parasitic fibers do, however, pick up and transmit light that is lost from one or more of the transmitting fibers. The light that is picked up by the parasitic fibers is fed to a sensor/detector that can determine the amount of light being output from these parasitic fibers. Based on factors such as the ratio of parasitic fibers to transmitting fibers and the length of the fibers, the level of light output by the parasitic fibers to the detectors determines whether more or less power is needed to be output from the light source in order to maintain a steady output from the transmitting fibers. The power adjustment determination is performed by a conventional feed-back circuit. Based on the information “fed back” to the light source, the level of light input into the transmitting fibers is adjusted to

maintain a relatively constant output by the transmitting fibers (*i.e.*, the greater the loss, the greater the level of power needed to be generated by the source) and account for light output variation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is a schematic representation of the present invention.

[0010] Fig. 2 is an enlarged schematic representation of a parasitic fiber and a transmitting fiber positioned near one another according to the present invention.

[0011] Fig. 3 is a cross-sectional view taken along line A-A of Figure 1.

[0012] Fig. 4 is a schematic representation of another embodiment of the present invention.

[0013] Figs. 5-7 are schematic representation of feedback circuits that may be incorporated into the present invention for determining power adjustment according to the present invention.

[0014] Fig. 8 is a schematic representation of another embodiment of the present invention.

DETAILED DESCRIPTION

[0015] Referring now to the drawing figures, wherein like reference numerals refer to like parts throughout, there is seen in Figure 1 a device for monitoring the amount of EMR variation during transmission and adjusting the EMR source accordingly designated generally by reference numeral 10. Device 10 comprises a transmission bundle 12 of optical fibers joined together by a common ferrule 14, and a parasitic bundle 16 of optical fibers joined together by a different ferrule 18 and intermingled along at least a portion of its length with transmission bundle 12.

[0016] Ferrule 14 interconnects the input end of transmitting fibers 12 to a light (EMR) source 20, while ferrule 18 interconnects one end of parasitic fibers 16 to a detector 22. Hence, transmitting fibers 12 are interconnected with a light (EMR) source 20 for transmitting light

through fibers 12 to an optical device (not shown), while parasitic fibers 16 do not include an original light (EMR) source.

[0017] With reference to Figures 2 and 3, an individual transmitting fiber 24 in transmission bundle 12 transmits light via internal reflection along its lengths. Some portion of that light will be lost due to imperfections in the fibers, the orientation of the fiber, and other physical factors known to contribute to the loss of light from a conventional optical fiber. The light lost from transmitting fiber 24 passes into an individual parasitic fiber 26 in parasitic bundle 16 positioned adjacent thereto.

[0018] The light received by parasitic fiber 26 is transmitted therealong to detector 22. Detector 22 contains standard feedback circuitry, such as any of the circuits illustrated in Figures 5-7, or equivalents thereof. Based on known optical fiber parameters, such as the length of fibers 24 and 26, the ratio of the number of transmitting fibers 24 in transmission bundle 12 to the number of parasitic fibers 26 in parasitic bundle 16, and the amount of light to be delivered by transmission bundle 12, the amount of light (EMR) input by source 20 into transmission bundle 12 can be increased or decreased proportionately to compensate for the amount of light lost or gained by transmission bundle 12. In other words, detector 22 determines the light (EMR) gain or loss from transmission bundle 12 and then attenuates or boosts the light input from source 20 to maintain a constant output.

[0019] Parasitic bundle 16 can terminate in a detector 22 that is positioned adjacent the output end of the transmission bundle 12, as seen in Figure 1, or can terminate in a detector 22 that is positioned adjacent source 20, as seen in Figure 4. If detector 22 is positioned adjacent source 20, parasitic fiber 26 must reflect the light carried therein backwards towards source 20 to reach

detector 22. To improve the accuracy of the information provided by detector 22, parasitic fibers 26 may be randomly distributed throughout transmission bundle 12, as illustrated in Figure 3. The more parasitic fibers 26 provided in bundle 12, the more accurate the loss/gain information will be.

[0020] With reference to Fig. 8, parasitic fibers 26 may be positioned just outside of ferrule 14 and randomly distributed as seen in Fig. 3. In the manner, ends of parasitic fibers 26 receive light (EMR) from source 20 that passes through the epoxy in the interspatial gaps of transmitting fibers 24. Conventional epoxies may be used to control the power and/or wavelength of the feedback into the ends of parasitic fibers 26.